



Flight Manual Hotair-Airship AS 105 GD

Version GD/4 and GD/6



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This Flight Manual is EASA approved under the Approval Number: 10029984
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This Flight Manual is issued for the Hotair-Airship

Registration:

SN Envelope:

SN Gondola:

This is to confirm, that this Flight Manual for the above mentioned Hotair-Airship is a legal document. It is written in accordance with the actual build standard and this build standard complies with the Certificate of Airworthiness. This Flight Manual has to be carried on board at all times.

This Manual is valid for the following serial numbers: Envelope: SN 0050, SN 0056 and subsequent numbers; Gondola: SN 0025, SN 0027 and subsequent numbers.

The gondola type plate (manufactured from fire proof material) is attached to the firewall above the engine. A second plate is attached to the envelope in front of the keel opening (gondola position).

The regulations, accident prevention instructions and guidelines i.e. rules relevant for the operation of pressurised gas cylinders and liquid gas devices are to be obeyed in conjunction with the instructions of this Flight- and the Maintenance Manual.

Furthermore, relevant regulations independent from the aviation sector concerning refilling procedures of pressurised gases have to be obeyed.

The Hotair-Airship shall only be operated in accordance with the instructions and defined operational limitations of this Flight Manual and the Maintenance Manual.

The following definitions apply to warnings, cautions and notes used in this Flight Manual:

WARNING means that the non-observation of the corresponding procedure leads to an immediate or important degradation of the flight safety.

CAUTION means that the non-observation of the corresponding procedure leads to a minor or to a more or less long term degradation of flight safety.

NOTE draws the attention to any special item not directly related to safety but which is important or unusual.

Aachen, 20. May 2010

On behalf of GEFA-FLUG GmbH

Karl Ludwig Busemeyer

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A. Supplement And Revision Status

Changes and supplements are listed on this page.

Revision No.:	Affected Sections	Affected Pages:	Pages To Be Added:	Date:	Approval:

B. Abbreviations

AD/LTA	Luftfahrttechnische Anweisung (LTA) Airworthiness Directive
AdL	Aufrechterhaltung der Lufttüchtigkeit Airworthiness Management
APO/PO	Genehmigter Herstellungsbetrieb Approved Production Organisation
ARS	Personal zur Prüfung der Lufttüchtigkeit Airworthiness Review Staff
ARC	Bescheinigung über die Prüfung der Lufttüchtigkeit Airworthiness Review Certificate
CAA	Zivile Luftfahrtbehörde von Großbritannien Civil Aviation Authority United Kingdom
CAME/CAMO	Handbuch/Unternehmen zur Führung und Aufrechterhaltung der Lufttüchtigkeit Continuing Airworthiness Management Exposition/Organisation
CS	Freigabeberechtigtes Personal Certifying Staff
CofA	Lufttüchtigkeitszeugnis Certificate of Airworthiness
EASA	Europäische Agentur für Flugsicherheit European Aviation Safety Agency
DO	Entwicklungsbetrieb Design Organisation
LBA	Luftfahrt-Bundesamt
MEL	Mindestausrüstungsliste Minimum Equipment List
MOM/MO	Instandhaltungshandbuch/Instandhaltungsbetrieb Maintenance Organisation Manual/Maintenance Organisation
MTOW	Höchstabfluggewicht Maximum Take Off Weight
RPM	Umdrehungen pro Minute Revolution per minute
QM	Qualitätsmanagement Quality Management
SoC	Übereinstimmungsbescheinigung für Luftfahrzeuge Aircraft Statement of Conformity
SLL	Laufzeitbegrenzte Teile Service Life Limit
SSU	Seitenruder Steuerkraft Unterstützung Side Rudder Steering Power Assistant
TC	Kennblatt Type Certificate

1. Technical Description

1.1 Envelope

The aerodynamic envelope is manufactured using construction methods and materials established in the Hotair-Balloon Industry. The envelope is entirely made of coated nylon fabric.

The envelope has circumferential rip-stopping loadtapes spread along the entire length of the envelope. The envelope hull forms an enclosed structure apart from a small aperture in the keel, above the pilot's seat, and the pressure relief valves. The keel opening is closed by a sliding Plexiglas panel on the roof of the gondola. The pressure relief valves are closed by fabric panels so that the envelope forms a fully closed body.

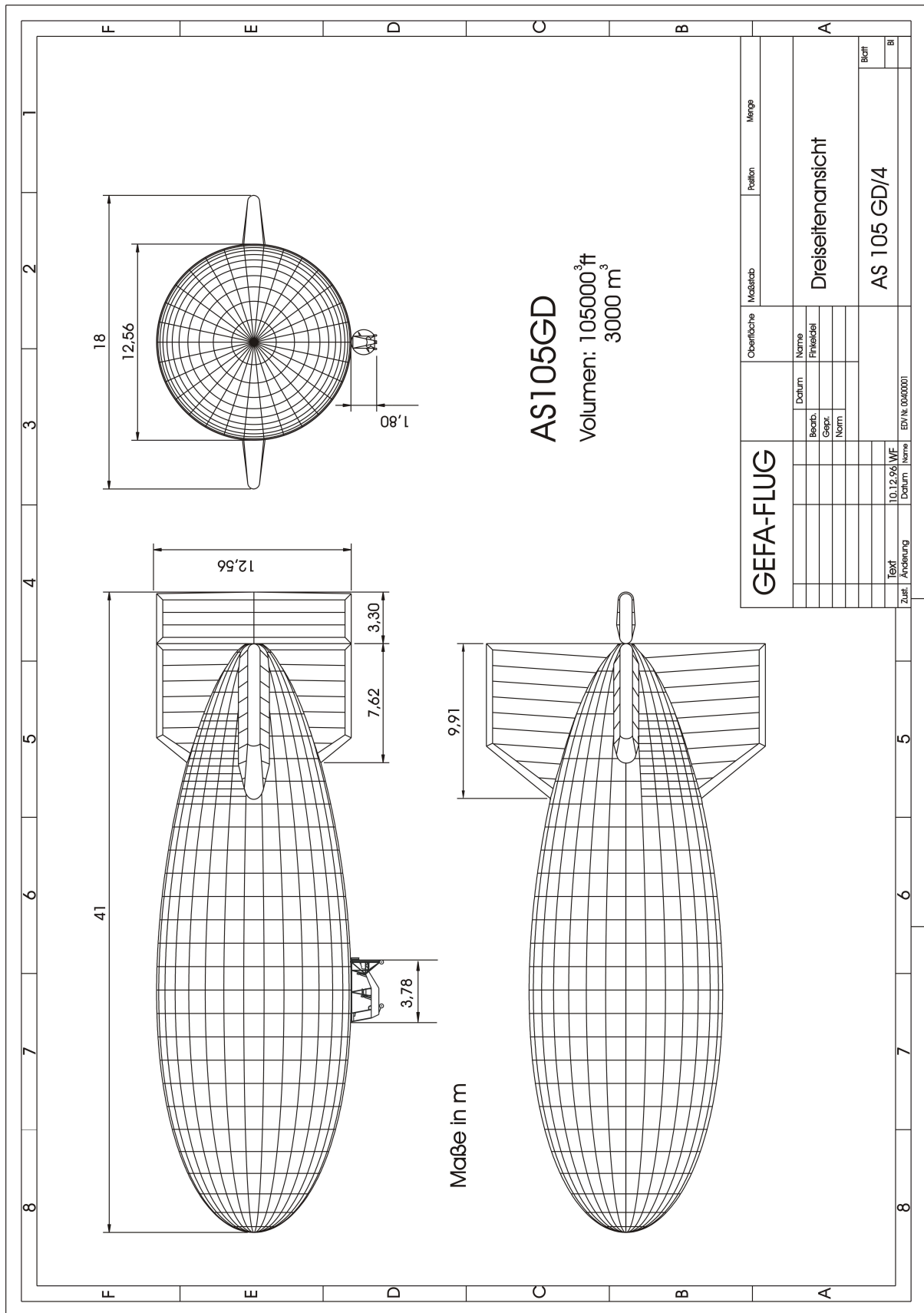
The empennage consists of two horizontal and two vertical fins which are in cruciform configuration. The empennage is inflated by the propeller slipstream via a scoop positioned directly behind the engine. The rudder is operated by control lines. The rudder deflection is 45° in both directions.

Placed in the upper part of the envelope (amidships) there is a light fabric membrane to damp the movement of air masses during climb or descent.

The gondola is suspended by the envelope on four hook-up points. The gondola forces are evenly transmitted into the envelope skin by two catenary curtains. A secondary suspension system (snaphooks) sewn to the envelope is connected to the upper gondola frame during assembly.

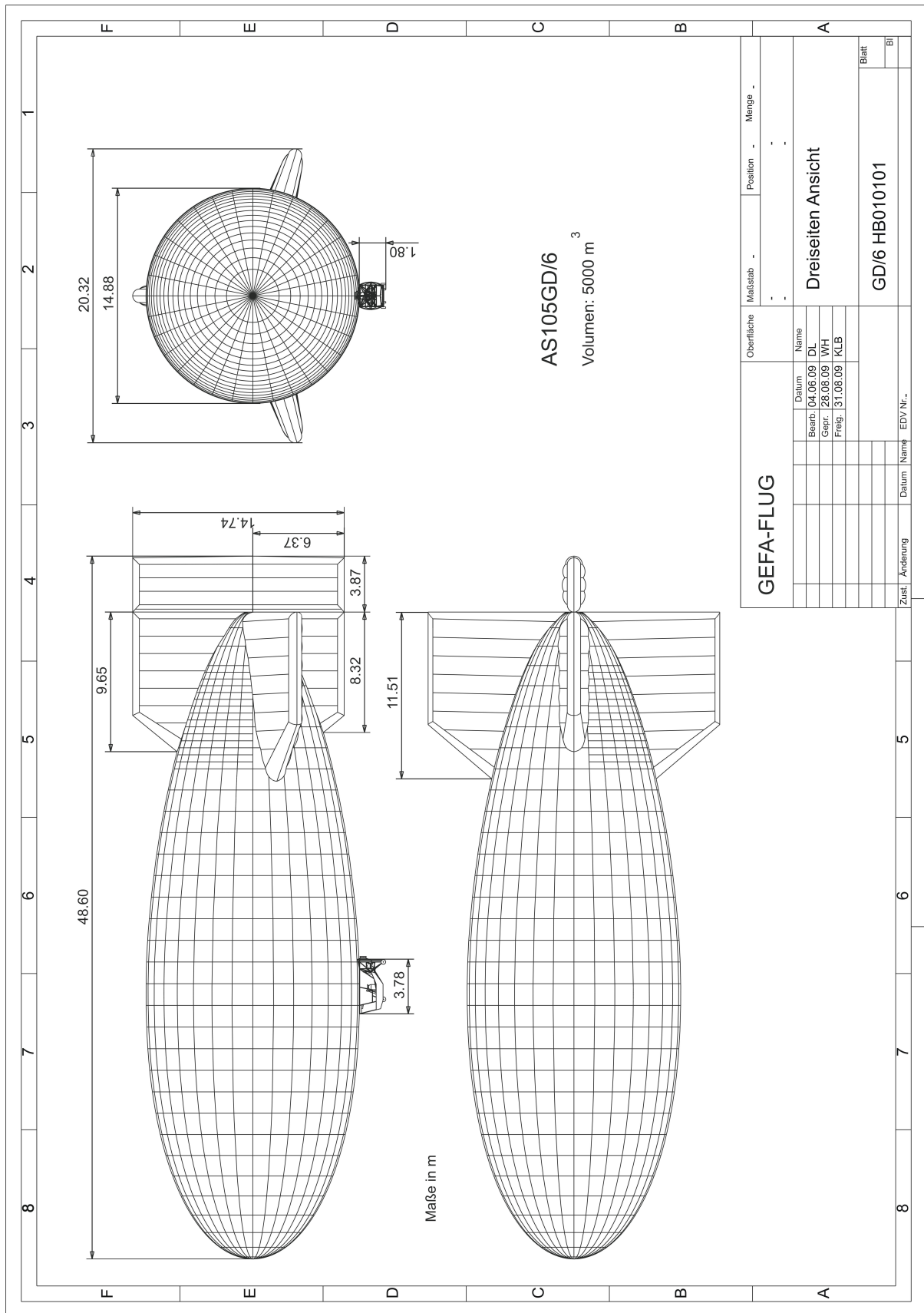
For fast deflation the envelope is fitted with a manually operated rip panel at the tail part (via a red line). The rip panel is situated between the upper vertical tail fin and the left horizontal tail fin.

WARNING: Once opened, the rip panel can not be reclosed. Therefore it is only to be used after final landing.





Three angle view envelope AS 105 GD/4

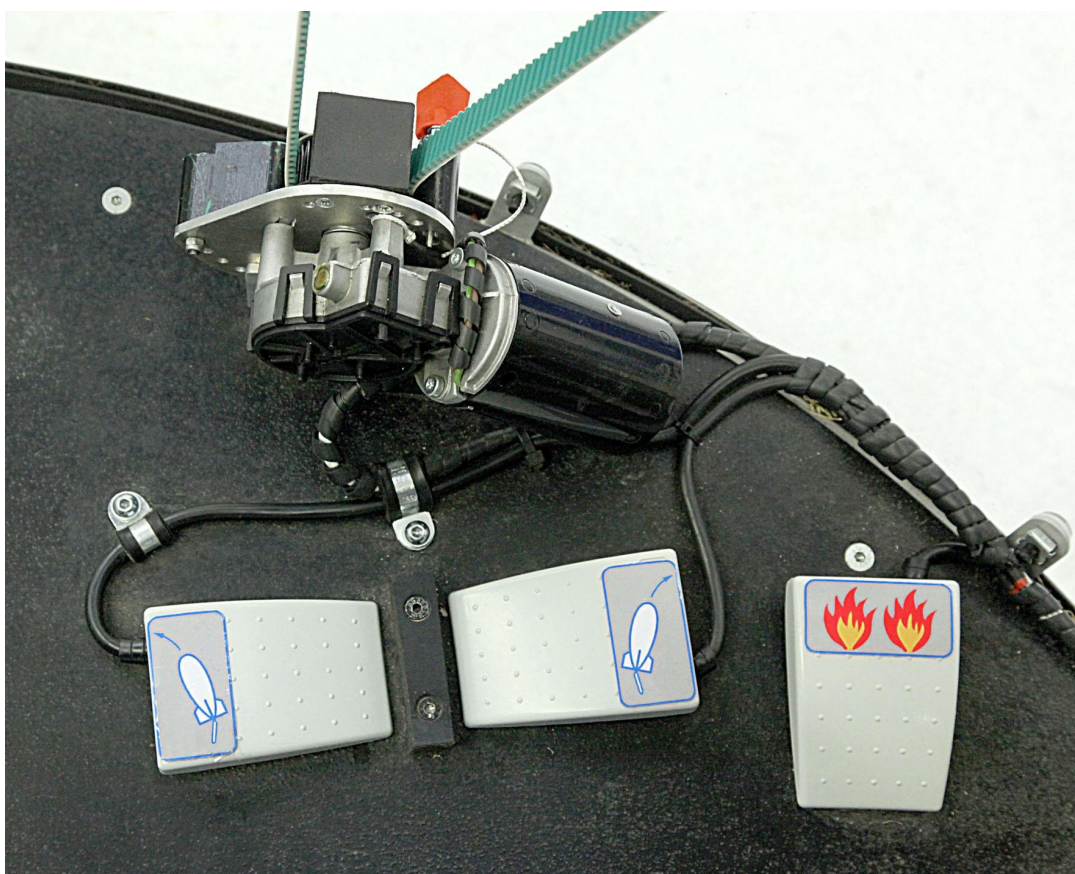




Three angle view envelope AS 105 GD/6

1.1.1 Side Rudder Steering Power Assistant (SSU)

To reduce pilot work load the airship can be fitted with an optional side rudder steering power assistant (SSU). This unit is operated by two footswitches (with placards) on the gondola floor in front of the pilot. To activate or deactivate the SSU the toggleswitch "Footswitches" (panel switchboard) has to be pushed forward or backward. In case of malfunction the SSU can be mechanically detached by pulling the red flagged safety-pin and removing the gear belt. The side rudder can then be operated as usual by pulling manually.



SSU and operating footswitches

SSU

Left footswitch (placard)	= Steering to the left
Middle footswitch (placard)	= Steering to the right

Burner Control

Right footswitch (flamesymbols) = Operates both standard burners

1.2 Gondola

1.2.1 Gondola Construction

The gondola consists of a tubular space frame manufactured from aerospace grade steel tubing. It has two rows of seats, set in a tandem configuration. The right front seat is reserved for the pilot.

The front of the gondola is covered by a Plexiglas windshield. The lower parts of the sides are also covered by Plexiglas panels.

NOTE: The gondola versions GD/4 and GD/6 are not interchangeable.

The roof of the gondola is closed above the front row of seats and has a hatch above the pilot. This hatch is closed by a sliding Plexiglas panel which seals the envelope. Through Plexiglas sheet the inside of the envelope and the burner assembly can be seen.

The doubleburner is mounted on top of the upper frame on the front of the gondola and can be rotated to the right (in flight direction) for inflation. The burner will fold down inside the gondola for transport. The burner can be reached during flight by sliding the Plexiglas panel backwards.

Above the cockpit, below the burner, an electric pressurisation fan system is mounted. It delivers fresh air to the burner and helps to establish the envelope pressure.

The propane cylinders are fastened to the gondola frame behind the front seats with straps.

The propulsion engine is mounted in the space frame behind the rear seats. The fuel tank is positioned below the rear seats, separated by a firewall.

The weight, torque and thrust loads from the gondola are transmitted into the envelope via four hook-up points on the top frame of the gondola. A secondary suspension system is formed by snaphooks as mentioned above. Landing forces are absorbed by four pneumatic tyres.

1.2.2 Propulsion and Pressurisation

Forward propulsion is provided by a ROTAX 582 twin cylinder, two stroke, liquid cooled engine. It drives a fixed pitch propeller via a gearbox. A tubular aluminium propeller guard protects the complete propeller arc from accidental contact with foreign objects or persons.

An alternator mounted on the propulsion engine produces the electricity needed to run all electric instruments and to drive the electric fan system. Together with the fabric scoop behind the propeller, it supplies the necessary airflow needed to sufficiently pressurise the envelope and to provide oxygen supply for the burner.

The scoop has two functions: it deflects air into the main envelope for pressurisation and it supplies air into the tail empennage to ensure good pressurisation and stability of the fins.

Two fabric pressure relief valves on the belly of the envelope (bow and stern) automatically regulate the internal envelope pressure.

1.2.3 Burner

The propane burner is in a V-configuration consisting of two main burners with a pilot light for each burner and, in the case of the GD/6, two liquid fire burners. The burner is fuelled by liquid propane. The propane supply is controlled via manually operated valves (between pilot's legs).

Each of the burner unit is fitted with a solenoid valve operated by a push button to the right of the instrument box. With the help of these buttons the burners can be operated separately or simultaneously, bypassing the manual override valves. During steady flight conditions both standard burners can be operated simultaneously by a foot-switch.

If the solenoid valves fail to work the burners can be operated manually via the manual valves between the legs of the pilot. (The functional diagram of the burnersystem and the propane management are described in Appendix 3a-3d.)

The burner pressure gauge is positioned at the burner in view of the pilot. The burner is mounted in a burner frame.

1.2.3.1 AutoHeat (Burntime Sequencer)

The airship is optionally equipped with a burntime sequencer (AutoHeat) to operate both burners. This device reduces pilot load because no manual burning is necessary during long term level flight. It can be switched on and off by a single toggleswitch. In any electrical mode all solenoid burner valves can be operated as usual.

To start the AutoHeat the on board electric system must be switched on, followed by the toggleswitch "ignition both burners" to be pushed forward. To finally start the AutoHeat the toggleswitch positioned on the AutoHeat must be pushed forward.

Three LEDs on the AutoHeat display the actual operating mode: one **yellow** LED signals AutoHeat is in standby (NORM), two **green** LEDs signal AutoHeat is in operation.

AutoHeat is controlled by a three step rotary switch in accordance with the actual propane pressure (Low, Mid, High). Via a slide control marked with a flame symbol the burning time of both burners is defined.



Burntime sequencer (AutoHeat)

1.2.4 Propane System

The propane system consists of the propane cylinders, valves, vapor regulators, burners and connecting hoses.

The liquid propane is stored in cylinders containing a propane volume of 20, 30 or 40 kg each. The propane cylinders are positioned behind the front row of seats. Each cylinder has a contents gauge, valves for liquid and vapour take off, fixed liquid level gauge and a pressure relief valve set to discharge at 26 bar (375 psi/2.6 MPa). The propane cylinders are protected against accidental operation by protective hoods.

If vapor pilot lights are fitted, the propane cylinders must be equipped with separate vapor supply (Appendix 2).

Where liquid pilot lights are fitted, the propane system consists of the propane cylinders, valves, burners and connection hoses. Each cylinder has a single liquid fuel supply to the burner with a mechanically operated shut off valve (Appendix 3 a-c).

If the burner system is equipped with liquid pilot lights, standard cylinders (without vapor supply) can be used. Additional certified propane cylinders are listed in Appendix 2.

1.2.4.1 Pilot Light Ignition System

There is a pilot light built into each burner can. The pilot lights are vapor or liquid fed and are lit by two independent electronic ignition systems. The second ignition system is independent from the main power supply and is powered by two 9 V dry batteries positioned in an enclosure underneath the burner panel.

1.2.4.2 Liquid Pilot Light System

The pilot lights are fed by liquid off take from the main supply. The liquid passes through shut-off valves, attached to the burner frame, into a vaporiser under the pilot flame tube. The system is duplicated for the front and rear burner. (Sketch Appendix 3a, 3c)

1.2.4.3 Vapor Pilot Light System

If the pilot lights are fed by vapour propane, cylinders must be used with a separate vapour supply. Each burner is fitted with a separate system (Sketch Appendix 3b, 3d).

1.3 Petrol System

The petrol tank is fitted with a filler cap, a remote filling level indicator, shut off valve with filter, drain tap and an air vent.

From the tank the petrol-oil-mixture runs through the shut off valve to the fuel pump. The pump is a membrane type and is powered by the engine. An electric fuel pump is fitted additionally which can be operated from the switch panel.

The petrol shut off valve can be operated from the pilot seat by a Bowden control cable. The engine is fitted with a choke for cold start which can be operated manually from the pilot seat. The choke lever is spring supported and jumps back to its neutral position. The petrol tank is separated from the gondola passenger compartments and the engine by a fire wall.

1.4 Instrumentation

The instruments and all other electrical switches necessary for operation are housed in the instrument box mounted in the front of the gondola on the right hand side from the pilot's position.

For details see following images:

- A. Instrument Box
- B. Switch Panel
- C. Burner Activation
- D. Burner Activation during Hot-Inflation

A. Instrument Box

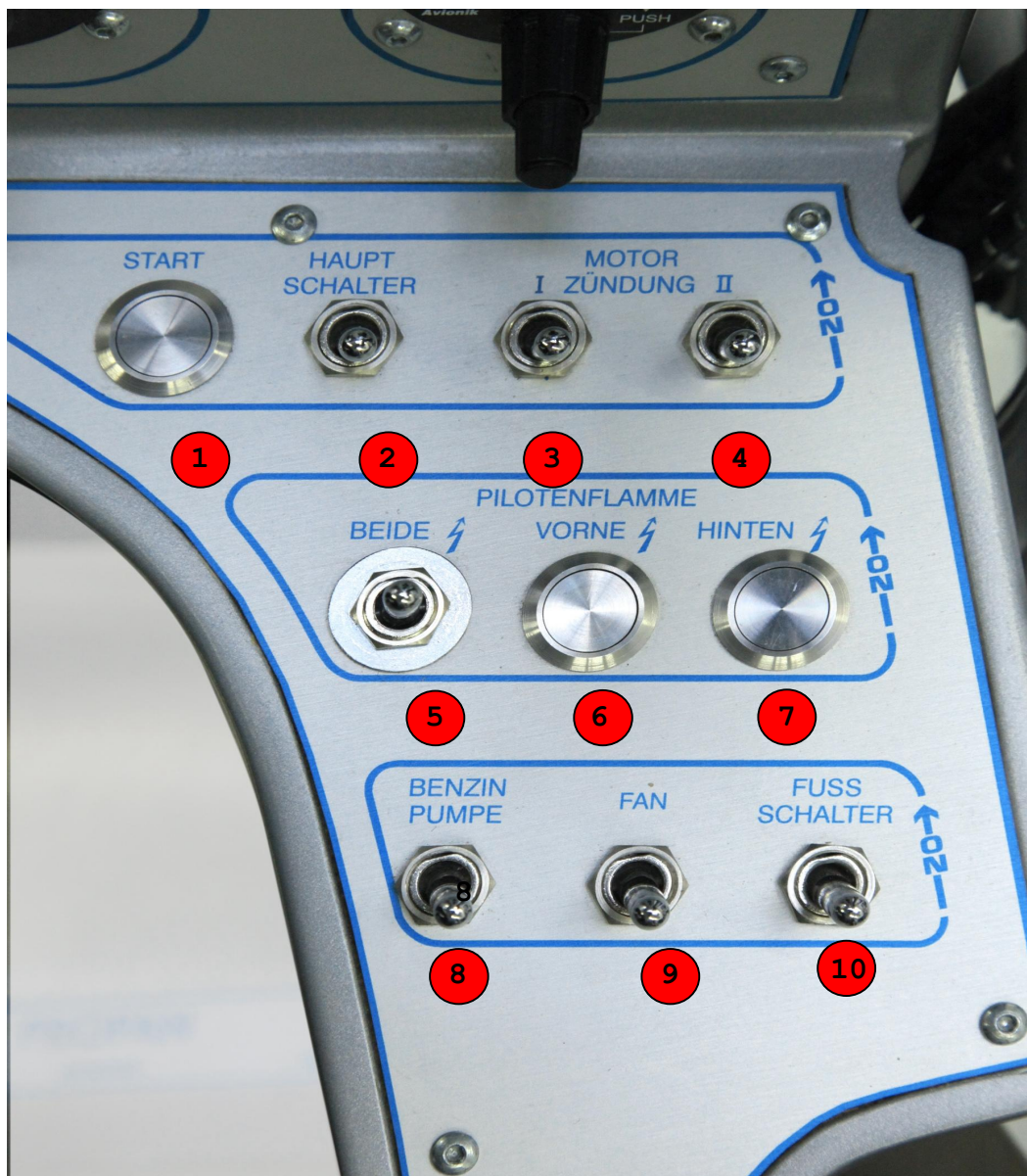


Instrument Panel (Explanations on the following page)

The Instrumentenpanel shows:

Engine Monitoring:	6	Rev. Counter
	7	Coolant Temperature
	8	Petrol Tank Fuel Gauge
	2	Generator Warning
Envelope:	5	Envelope Pressure Gauge
	1	Envelope Temperature Gauge
Flight Instruments:	1	Altimeter
	1	Variometer
Avionics:	4	VHF Radio
	3	Intercom
	9	Transponder (optional)
Further instruments (not placed in the instrument panel)		
Inclinometer	Position: Windscreen right-hand	
Propane Pressure Gauge	Position: Burner Unit	
Propane content	Indicator on propane cylinders	

B. Switch Panel AS 105 GD



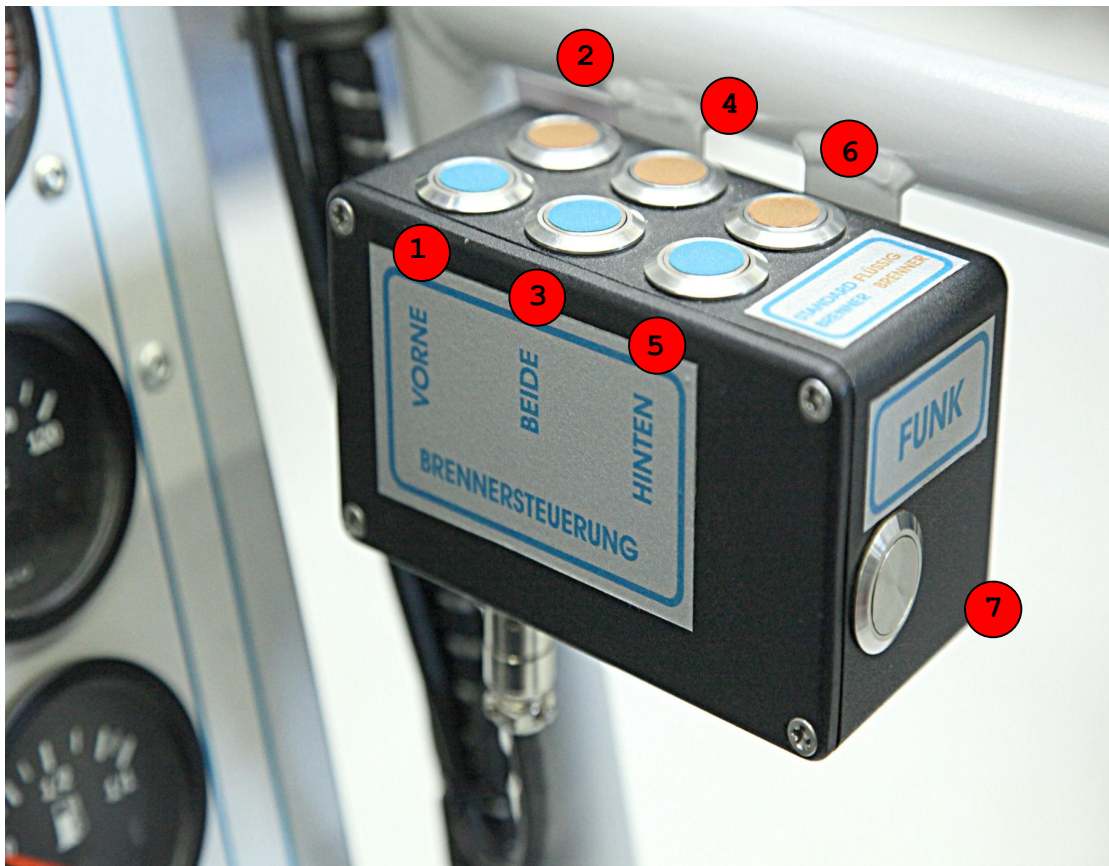
1. Starter
2. Main Switch
3. Ignition Circuit Propulsion Engine I
4. Ignition Circuit Propulsion Engine II
5. Ignition Pilot Light both burners
6. Ignition Pilot Light forward burner (9 Volt)
7. Ignition Pilot Light rear burner (9 Volt)
8. Electric petrol pump
9. Electric pressure fan system
10. Footswitch Double Burner (and SSU if fitted))

C. Burner Activation AS 105 GD/4



1. Front Standard Burner
2. Both Standard Burners
3. Rear Standard Burner
4. Transmit Button VHF Radio

D. Burner Activation AS 105 GD/6



1. Front Standard Burner
2. Front Liquid Burner
3. Both Standard Burners
4. Both Liquid Burners
5. Rear Standard Burner
6. Rear Liquid Burner
7. Transmit Button VHF Radio

D. Burner Activation AS 105 GD/4 and GD/6 during Hot-Inflation



The above pictured assembly is positioned under the fan-panel left hand of the gondola.

This burner control unit consists of two push buttons which help the pilot during hot inflation to operate each of the standard burners or both standard burners parallel. With one hand the pilot can tilt the burner, with the other hand he can operate the front, the rear or both burners.

1.5 Safety Equipment

The safety equipment consists of:

- one ABC-fire extinguisher between the front seats, a second one between the rear seats.
- A 30 m drop line is in reach of the pilot
- GD/4: A first aid kit and a fire blanket are located under the instrument panel (GD/4)
- GD/6 A first aid kit and a fire blanket are located between the front and the rear seats (GD/6).

1.6 Filling Capacities

Propane	20-40 kg content stored in gas cylinders (Appendix 2) GD/4: 2x30 kg GD/6: 3x40 kg
Petrol	Regular grade, leaded or unleaded (not below MOZ 83 or ROZ 90) GD/4: 30 litres GD/6: 50 litres
Lubricant	Super-two-stroke engine oil (ASTM/CEC Standard; TSC 3 –classification) mixture 1:50 (2%)
Cooling System	Aluminium Radiator anti-freeze (refer to ROTAX engine manual) Volume: 2 litres
Tyre Pressure	Minimal 1,5 bar (0,15 MPa) Maximal 5,0 bar (0,5 MPa)

1.7 On-Board Electrical System

1.7.1 External 12 Volt Power Supply

On the right hand of the front entry of the gondola (red marked, located on the metal sheet) there is an external connection for 12 Volt power supply, which can be used to charge the starter battery or to start the engine in case of weakness of the starter battery.

1.7.2 Fuses AS 105 GD/4

Located in the front entry of the gondola are numbered fuses (position: metal sheet between the pilot's legs). They are color coded according to their individual strength. There are backup fuses for each type located separate directly next to the fuses.

No	Designation Bezeichnung	Amp
--	Pull-Fuse (red marked) Zugsicherung (rot markiert)	100
1	Master Switch Batteriehaupschalter	35
2	Generator 1	20
3	Generator 2	20
4	Fan Ventilator	30
5	Transponder Antwortsendegerät	3
6	Burner Brenner	3
7	Aircraft Radio Flugfunkgerät	3
8	Fuel Pump Benzinpumpe	3
9	Engine-Starter Motorstarter	3
10	Flytec Instrument	3

1.7.3 Fuses AS 105 GD/6

Located in the front entry of the gondola are numbered fuses (position: metal sheet between the pilot's legs). They are color coded according to their individual strength. There are backup fuses for each type located separate and directly next to the fuses.

No	Designation Bezeichnung	Amp
--	Pull-Fuse (red marked) Zug-sicherung (rot markiert)	100
1	Master Switch Batteriehaupschalter	35
2	Fan 1 Ventilator 1	35
3	Fan 2 Ventilator 2	35
4	Fan Relais Ventilator Relay	3
5	Transponder/ Antwortsendegerät	3
6	Standard Burner Standard Brenner	3
7	Aircraft Radio Flugfunkgerät	3
8	Fuel Pump Benzinpumpe	3
9	Engine-Starter Motorstarter	3
10	Flytec Instrument	3
11	Generator 1	35
12	Generator 2	35
13	Liquid Burner Flüssigbrenner	3
14	Left blank nicht belegt	--
15	Left blank nicht belegt	--

2. Flight Instructions (EASA Approved)

2.1 Weather Conditions

The max. wind speed on the takeoff site shall not exceed 12 knots for an experienced pilot and, as a recommendation, 8 knots for an inexperienced pilot.

NOTE: With increasing wind speed during flight a return flight to the launch field might not be possible.

WARNING: Flights in thermal or thundery conditions are not permitted.

2.2 Pre-Inflation Checks

To ensure a smooth and fast inflation an extensive briefing of the ground crew is necessary.

First of all, the dangers of the main propeller, the petrol inflation fan and the electric pressure system, when in operation, have to be emphasised. The ground crew should be especially warned about scarves, ropes and long hair being sucked into the main propeller or into the electric fan system. Only authorised persons are permitted to approach the gondola. The gondola should be positioned facing into the wind. The burner is to be raised and secured.

The following gondola checks are carried out prior to the actual assembly:

Propulsion engine:

NOTE: All instructions of the ROTAX engine manual are to be obeyed.

- Nuts and bolts tight (engine mounts, alternator brackets, propeller and exhaust)
- Drain some petrol from tank and examine for water contamination
- Radiator cooling liquid
- Battery connections
- Exhaust system for damages and cracks
- Radiator system and hoses for leaks
- Petrol fuel lines for leaks
- **NOTE: The ground crew should restrain the gondola to prevent it from moving once the engine is running**
- Apply full choke on cold engine
- Push starter button and start engine
- Once the engine is running close choke as soon as possible. Prolonged use of choke can cause engine to flood. The choke lever jumps back to its neutral position by itself

Continuation: Propulsion engine

- Shift the throttle lever to 3.500/4.000 RPM until the radiator coolant temperature raises to 60 °C, followed by a full throttle engine run for a short time (max. permitted 6.200 rpm)
- Check ignition circuits 1 and 2; engine running at 3.000 to 3.500 RPM. Alternately ignition circuit 1 and 2 must be switched off; the engine revolution drop must not exceed max. 300 rpm
- Switch on pressurisation fan system while engine is running on idle and check engine performance
- Switch "Off" electric pressurisation fan system and engine

Propeller

- Check propeller serviceable
- Nuts and bolts for tight
- Check safety pins in castellated nuts
- Propeller blades and propeller guard for damages

Petrol tank

- Petrol level (min. 25%)
- Open fuel stop cock. Check hoses for leaks
- Fuel tank for leaks
- Ensure fuel filler cap is tightly closed
- Drainage for water contamination

Propane cylinders

- Propane level (min. 25 %)
- Cylinder straps for security and condition
- Propane hoses for leaks and signs of wear
- Fittings for leaks (**WATCH, SMELL, and LISTEN**)
- Tight fit of cylinder protective hoods

Burner

- Both electric ignition systems for the pilot lights
- Pilot lights for stable flame pattern
- Functional check of the burner using solenoid and manual valves
- Burntime sequencer (AutoHeat) (if fitted)
- Swivel mechanism

Tyres

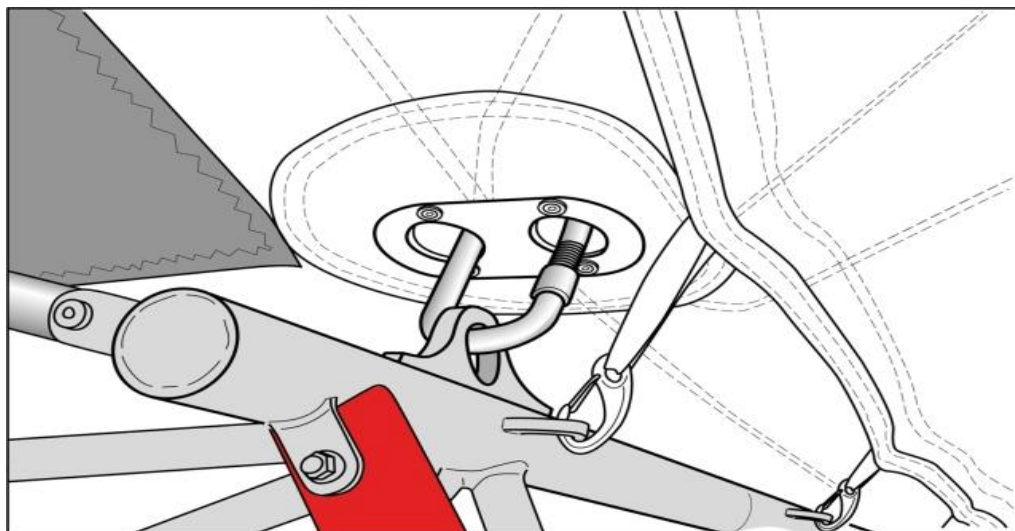
- Tyre damage and tyre pressure (1.5 bar/0,15 MPa)

Side Rudder Steering Power Assistant (SSU)

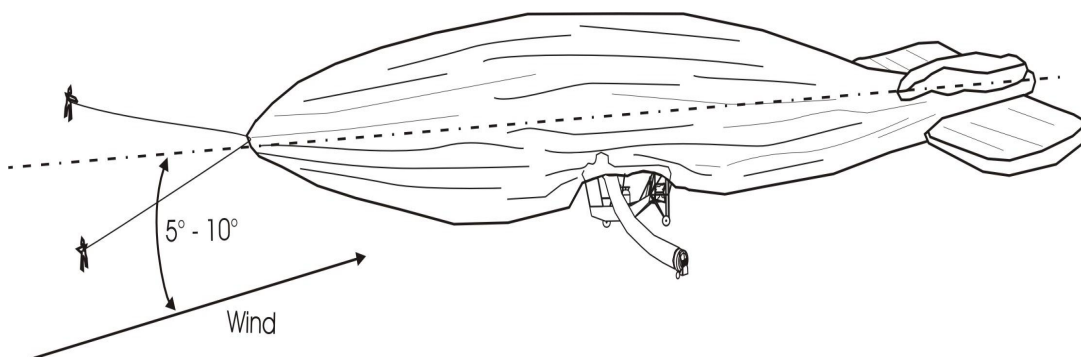
- Function Test SSU (if fitted) including uncoupling

2.3 Assembly

- Position car and trailer into wind
- Lay out envelope on the starboard side of the gondola. Gondola and envelope should be laid out 5° to 10° to the right of the flight direction (see sketches of inflation procedure)
- Attach envelope flying wires with the karabiners to the gondola in the following order: 1) front left, 2) front right, 3) rear left, 4) rear right



- Connect snaphooks to gondola frame
- Connect scoop including snap hook
- Spread out envelope, fins and rudder
- Close rip panel (both long sides first, short side last), close safety locks
- Connect rudder lines
- Check all lines of the envelope for entanglement and free movement
- Check rubber cords, lines and loops of the envelope overpressure valves on proper conditions
- Close numbered velcro slots of the side-fins (2 slots GD/4; 3 slots GD/6), of the rudder (4 slots GD/4; 5 slots GD/6) and 1 slot in the stern of the envelope body



Sketch inflation: View from above on uninflated envelope

2.4 Inflation Procedure

The description assumes standard conditions:

Depending on weather conditions, crew skills (crew chief and 2-3 trained assistants), the take-off site and other factors, the inflation process may vary.

WARNING: The launch and the landing site (size of about 80 m x 80 m) should be dry, clean and free of obstacles for a normal departure and final approach leg. Free of obstacles means, that during a normal take-off and landing procedure in a 30° take off and approach funnel obstacles of 15 m height can be overflowed in secure height.

It is required that two crew members are holding the two nose lines during the inflation process (gloves!). The distance between them should be approximately 10 m. They have to stay in visual contact with the pilot to keep the envelope under control according to pilot's requests.

The envelope is filled with air via a fabric trunk by an external petrol fan through the closable hatch in the gondola's roof.

All lines inside and outside the envelope are to be checked for free run during inflation, especially the catenary curtain must not be entangled and must be clearly visible. Check envelope from inside and outside for tears and any other damage. Check rudder lines outside for free run.

1. It is not permitted to fly with holes or tears above the envelope equator larger than 5 mm diameter
2. It is not permitted to fly with holes or tears below the envelope equator larger than 10 mm diameter
3. It is not permitted to fly with holes or tears in the fins larger than 10 mm

NOTE: No damage may be caused by entering the envelope during the cold inflation process (if possible step in without shoes).

Inflate the envelope with cold air to about $\frac{3}{4}$ and then start the hot inflation. The more the envelope is filled with cold air, the simpler the hot inflation process.

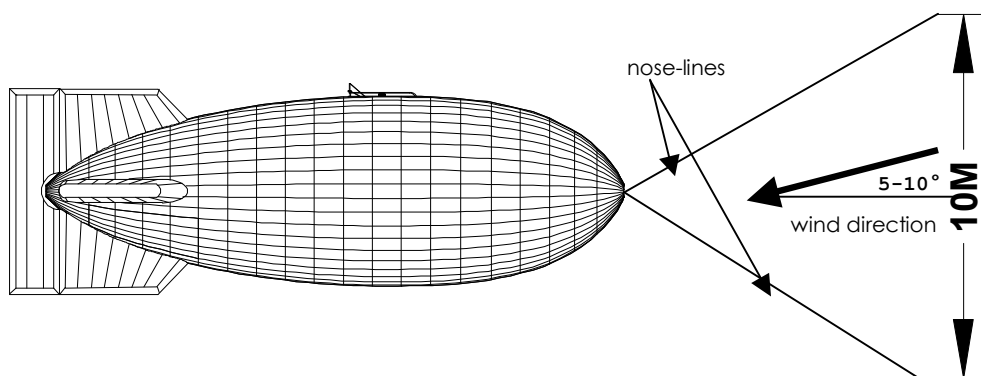
As a general rule there must always be one crew member on the left side of the gondola to avoid tipping over of the gondola due to wind gusts or other impacts.

The external fan runs on idle during this process. Swivel the burner to the right. Operate the burner and slowly swivel back to the original upright position as the envelope rises. The pilot has to aim the burner flame in such a way as to ensure that no envelope material or inner rigging is exposed to excessive heat.

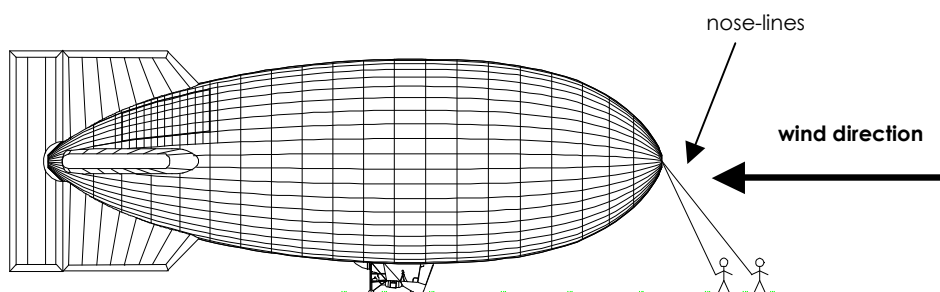
NOTE: Whenever possible the rear burner should be used during inflation to lift the rear envelope part from the ground to help the nose-crew keeping the envelope down. The workload of the nose crew is reduced, if the nosepart is kept down to the ground as long as possible.

The crew members on the nose lines should not allow nose or tail of the envelope to rise individually. They keep the ship level with the horizon by carefully pulling the nose lines down or letting the nose lines go to avoid burn damages to the envelope. They slacken the nose lines when the envelope inevitably moves sideways (righthand in flight direction) during the hot inflation (the envelope positions itself on top of the gondola) and follow the movement of the envelope.

Once the airship is fully buoyant disconnect the inflation trunk and close the hatch above the pilot seat with the sliding Plexiglas panel. Keep the envelope into wind and in level by means of the two nose lines.



View from above when inflated



Side view when hot inflated

2.5 Pre-Flight Checks

The airship is up and buoyant but has not yet reached take-off temperature:

NOTE: From now on only authorised persons are permitted in the close proximity of the airship. As a general rule everybody has to follow the pilot's instructions.

- Instruction of the passengers (Crew Chief) (see section 2.12)
- First use the rear seats, than the front seats from the left gondola side
- Secure loose things.
- Smoking is forbidden during flight.
- Do not open safety belts before authorisation by the pilot (after landing is finished).
- Check: Is propeller clear?
- Start propulsion engine (fins start to fill and pressurise)
- Start electric pressure fan system
- Rudder line (or gear belt if SSU is fitted) to be hooked to the burner - frame and gondola floor
- Check side rudder to full extension to the left, neutral and right side
- Check all lines for free run
- Check correct operation of envelope pressure relief valves
- Check readability of the content gauges on the propane cylinders using the mirrors
- Check position of protective hoods
- Use the burners until lift is reached

Final Checks

- Check seat belts fastened
- Check front and rear secondary passenger safety belts
- Check correct operation of pilot lights (stable flame pattern)
- Check propane pressure (4 – 12,8 bar (0,4 – 1,28 MPa))
- Check engine for smooth operation on both ignition circuits up to full throttle
- Check altimeter
- Switch on variometer and temperature gauge

2.6 Take-Off

- The airship is to be brought precisely into wind by using the nose lines
- The airship will take off after further heating
- **CAUTION: Always monitor envelope pressure, max. 15 mm H₂O (150 Pa)**
- Only on pilot's instructions to the crew: release nose lines

2.7 Flight

The airship is controlled in its movements by three different inputs:

- The burner controls the climb and descent rate of the airship
- The engine delivers the forward thrust of the airship
- The rudder enables the airship to make changes in the yaw axis

2.7.1 Envelope Superpressure

The pressure in the envelope is achieved by the electric fan system and the propeller which supplies air into the envelope via the scoop to sustain the combustion and the internal pressure. At sufficient internal pressure the envelope will maintain its shape even when flying at higher speeds.

The pressure will increase, if more air is supplied into the envelope at high engine revolutions, or if the air inside the envelope expands by using the burner. The pressure will vary between 5 – 10 mm H₂O (50 – 100 Pa) during flight. Operating with full burner power, running the engine at full throttle the envelope pressure should not increase above 15 mm H₂O (150 Pa).

Standard values envelope super pressure:

RPM	Envelope super pressure
Idle – 3.000 RPM	5-6 mm H ₂ O (50-60 Pa)
3.000 RPM – 4.500 RPM	6-9 mm H ₂ O (60-90 Pa)
4.500 RPM – full throttle (6.200 RPM)	9-12 mm H ₂ O (90-120 Pa)

During fast descent rates the envelope pressure might decrease, at fast climb rates it might increase a bit more.

NOTE: The interacting physical relations between propane pressure, use of the burners, temperature changes, rate of climb and descent, envelope pressure and engine input must be properly understood by the pilot to use the airship to its full potential.

2.7.2 Aerodynamic Lift

Unlike a Hotair Balloon a Hotair Airship is influenced by aerodynamic as well as aerostatic effects. The airship is subjected to the combination and magnitude of these forces depending on flight conditions in each particular case.

At a slight positive inclination angle and full engine thrust it is possible to create approximately 5-10% of the total lift aerodynamically based on the higher flight speed. If the engine thrust is reduced the flight speed will decrease and thus the aerodynamic lift. It is necessary then to add extra heat to keep the actual flight altitude.

WARNING: Sudden engine failure during a high speed approach to land with a positive inclination angle an unintentional landing might occur due to a loss of aerodynamic lift (a failing engine results to a reduced flight speed), if not compensated accordingly and appropriately using the burner (check the inclination angle at the inclinometer).

2.7.3 Fuel Management

A. Propane

Version GD/4

Both propane cylinders are of equal value. Only one propane cylinder should be open. The second one is to be opened when the first cylinder indicates a remaining quantity of about 25 %. Maximum flight time is approx. 1 hr with a consumption of approx. 60 kg/hr.

Version GD/6

Both the left and the right propane cylinder have to be open. The one in the middle will be kept closed until the two others indicate a remaining quantity of about 25 %. Maximum flight time is approx. 2 hrs with a propane consumption of approx. 60 kg/hr.

B. Petrol

Check petrol fuel level (instrument box). Fuel consumption is approximately 15-20 l/h at 5.000 rpm.

2.8 Pre-Landing Checks

- Landing procedures should be initiated when 30% of content remains in the last propane cylinder
- Check petrol fuel level
- Overfly landing site to check for possible changes in wind direction (pay attention to the windsock at the landing field or close to)
- Inform ground crew via radio about the intention to land
- Switch AutoHeat "OFF" (if fitted)

2.9 Landing

- The landing is always made into wind
- Landing site free of obstacles
- The rate of descent during the landing approach is determined by the cooling rate of the hot air in the envelope together with loss of aerodynamic lift when flying "nose up" (ref. 2.7)
- The ground crew plays an important role in the landing phase: it is their task to catch the nose lines, to bring the airship to a complete stop, to establish a good tether
- Direct the airship into wind with the help of the nose lines

WARNING: The engine should be switched "OFF" immediately before touchdown to avoid foreign objects being sucked into the propeller as well as ensuring that the ground crew does not get into contact with the propeller.

2.10 Deflation

- Position the air ship with its nose into wind
- Shut down pilot lights and electronic ignition
- Vent liquid propane through the burner to cool it
- Close propane supply to burner and vent lines
- Shut down electric pressure fan system
- Close petrol fuel tap
- Master switch – "OFF"
- Open rip panel completely
- Pull down the airship nose (in flight direction on right hand of gondola) and hold it to the ground
- Open deflation holes in the fins
- Disconnect scoop attachment
- Disconnect rudder lines (or gear belt if SSU is fitted)
- Disconnect envelope (karabiners and snaphooks) from gondola
- Press remaining air out of the envelope and fins by packing envelope lengthwise (starting from its nose)

2.11 Propane Fuel Pressure

The propane operating pressure varies from 4 to 12.8 bar (0,4 – 1,28 MPa). Care should be taken with propane pressures below 4 bar (0,4 MPa) as this can cause damage to the burner system due to massive radiant heat. Also the flight characteristics are impaired due to slow response caused by the reduced burner performance.

The propane pressure and therefore the burner power differ according to the ambient temperature. Adding nitrogen to the propane, the working pressure can be increased up to 8 bar (0,8 MPa) in the cold seasons (only cylinders without vapor pilot supply should be pressurised).

For pressurisation with nitrogen an industrial pressure regulator must be used between nitrogen cylinder and propane cylinder. The maximal allowed gas cylinder working pressure with nitrogen must not exceed (8 bar / 0.8 MPa).

2.12 Commercial Passenger Transport

For commercial passenger transport the airship shall be fitted and certified for Commercial Passenger Operations.

The pilot has to ensure, that the passengers are briefed prior to entering the gondola. The following subjects have to be pointed out (ref. section 2.5):

- Flight- and emergency procedures
- Smoking is not permitted during the flight
- Entering or leaving the gondola only with pilot's permission
- Entering or leaving the gondola always from the front left side
- No loose or free moving clothes (shawl, long hair, etc.) are allowed which can be sucked into the propeller
- Approaching the gondola is only allowed with permission of the pilot and only from the front left side of the gondola; never from behind (propeller is running)
- Seatbelts should only be opened on the instruction of the pilot (usually after landing)
- The instructions of the pilot are authoritative

The crew-chief must make sure before take-off that:

- Passengers do not use by chance controls or supply hoses as means of help to board or to leave the gondola
- Passengers are seated properly, seat belts fastened
- Secondary passenger safety belts are hooked on
- The propane cylinders in the rear passenger compartment are secured with protection hoods against uncontrolled use
- Loose objects are secured

3. Emergency Instructions (EASA Approved)

3.1 Flying the Hotair-Airship as a Hotair-Balloon

The airship is designed in such a manner that it is possible to fly it like a hotair-balloon (without engine power and without rudder), i.e. without pressurisation. The envelope will loose some of its shape and stiffness.

NOTE: The rate of descent is determined only by reducing the envelope temperature (the envelope does not have a self closing parachute).

To ensure better air supply to the burner, the sliding Plexiglas panel above the pilot seat should be pushed back. Flying without running the electric pressurisation system should not exceed 20 minutes or the heating power will decrease. The rip panel should only be used after the final landing.

3.2 Propulsion Engine Failure

- Ignition – “ON”
- Check fuel shut off – “OPEN”
- Check petrol level
- Check throttle lever and cable
- Throttle lever on idle position
- Check choke for correct setting “OFF”
- Switch electric pressurisation fan system “OFF”
- Restart engine

WARNING: If the propulsion engine does not start after various attempts and the starter engine starts to loose its power, refrain from further starting attempts to avoid battery collapse and a complete power loss (see section 3.7).

If engine does not restart:

- Switch electric pressure fan system “ON”
- Fly the airship as a hot air balloon
- **Land as soon as possible!**

3.3 Loss of Envelope Pressure

Loss of envelope pressure can be caused by the following factors:

- Pressure relief valve stuck open or rip panel is accidentally opened
- Tear in the envelope
- Insufficient pressurising air is entering the envelope via the electric pressure system (if the fan system fails, the pilot feels a warm breezing air in his face)
- Insufficiently fastened scoop

Action if envelope pressure has dropped down:

- Visually check that rip panel is closed
- Visually check envelope pressure relief valves for correct function
- Visually inspect envelope internally by opening the gondola roof hatch and look for holes, particularly in the upper half of the envelope
- Keep electric pressure system running
- Visually check scoop for proper function
- Use propulsion engine at practicable level
- **WARNING: If envelope pressure can not be regained, land as soon as possible!**

3.4 Pilot Light Failure

- Switch AutoHeat system - "OFF" (if fitted)
- Switch electric pressure fan system - "OFF"
- Put engine back on idle
- Check propane level
- Check pilot light valves – "ON"
- Re-ignite pilot lights using one of the two electronic ignition systems

If not successful:

- Open main burner manual override valves a fraction
- Ignite the propane at the main burner jets with one of the two electronic ignition systems
- Leave the manual override valve slightly open and let main burner act as constant pilot light
- Switch on electric pressure fan system
- **WARNING: Land as soon as possible!**

3.5 Burner Failure

NOTE: Functional diagram of the burnersystem and the propane management are described in Appendix 3a-3d.

- Switch AutoHeat - "Off" (if fitted)
- Check pilot lights – "ON" - and working
- Check propane shut-off valves – "OPEN"
- Check propane pressure
- Check propane level in cylinders
- Check solenoid valves serviceable
- If the burner cannot be re-lit: **WARNING: Prepare for a hard landing!**

If one of the solenoid burner valves has failed (closed or open):

- Switch AutoHeat – "OFF" - (if fitted)
- Open the manual by-pass valves (both burners)
- Use main shut-off valves (between pilot`s legs) as blast valve
- Even with only one burner working the airship can still be landed safely
- Keep electric pressure system running
- **Warning: Land as soon as possible!**

AutoHeat failure

- Switch AutoHeat „OFF“
- If it is not possible to switch the AutoHeat "OFF" pull the connector.

3.6 Fire On Board

A. Locate source and type of fire

Petrol or propane fire

- Close petrol fuel cock and/or propane valves on gas cylinders
- Release safety lock of fire extinguisher
- Aim fire extinguisher directly at base of fire
- Fight the fire
- Try to cover source of fire with fire extinguishing blanket

Electrical fire (wiring fire)

- Pull main fuse
- Release safety lock of fire extinguisher
- Aim fire extinguisher directly at source of fire
- Fight the fire
- Try to cover source of fire with fire blanket

B. Assess damage after the fire has been extinguished:

- Is an immediate standard landing possible and can be carried out with the given landing ground situation?
- Perform a normal landing
- Is an immediate landing (emergency landing or hard landing) necessary?
- **WARNING: Prepare for a hard landing!**

3.7 Electrical Power Supply Failure

A re-start of the engine is not possible if a power supply failure occurs. The solenoid valves do not work, the electric pressure fan system does not work. SSU (if fitted) is not working either. Thus the performance of the airship is limited.

- Fly the airship like a hotair balloon using the main **manual** gas valves. The descend of the airship is only achieved by temperature loss of the envelope
- Disconnect the SSU gear belt (if SSU is fitted)
- **WARNING: Land as soon as possible!**

3.8 Hard Landing

A hard landing is a landing with a higher rate of descent due to a major failure such as burner malfunction.

- Inform passengers about a possible hard landing
- Switch AutoHeat "Off" (if fitted)
- Check seat belts – they should be kept fastened tight until the airship has come to a complete stop after landing
- Close pilot lights
- Close gas valves and vent propane lines
- Leave electric pressure system running
- Keep propulsion engine running; it can be used together with the rudder to change the landing direction of the ship away from obstacles on the ground
- Shortly prior to landing: Engine "OFF", close fuel tab and isolate the electric system with the master switch
- Pull main fuse prior to touch down
- After landing, pull rip panel completely open

3.9 Landing In Strong Wind

- Inform passengers about a fast and possible bumpy landing
- Check and fasten seat belts tight
- The gondola might tilt on to its side when touching down or at deflation
- Always hold on to something inside the gondola.
- **WARNING: Always land into wind!**

4 Operational Limitations & Load Charts (EASA Approved)

4.1 Operational Limitations

Parameter	Version GD/4	Version GD/6
Max. permitted envelope temperature	127° Celsius	
Max. permitted rate of climb	3,5 m/s	3,0 m/s
Max. permitted rate of descent	2,5 m/s	
Loss of height at max. descent until equilibrium	100 % burner power at 6 bar propane pressure approx. 80 m	
max. surface wind speed in gusts	12 kts	
max. air speed in zero wind	$V_{max} = 9,0 \text{ m/s} = 32,4 \text{ km/h}$	
min. / max. envelope pressure	5 mm H ₂ O (50 Pa) / 15 mm H ₂ O (150 Pa)	
min. / max. persons	1 pilot / 4 persons	1 pilot / 6 persons
max. altitude	see load chart	
Propane pressure limits	4 – 12,8 bar (0,4 – 1,28 MPa)	
min. / max. continuous engine RPM	2.000 RPM / 6.200 RPM	
max. Take off weight (MTOW)	900 kg	1.488 kg
Gondola dry weight (depending on additionally carried equipment)	approx. 275 kg	approx. 360 kg
Envelope weight (depending on additionally carried artwork)	approx. 220 kg	approx. 360 kg
min./ max. tyre pressure	1,5 bar (0,15 Mpa) / 5,0 bar (0,5 MPa)	

4.2 Loading

General

The lift in kilograms is based on an envelope temperature of 120 °C (max. permitted is 127°C) and ISA-conditions (International Standard Atmosphere with temperature curves:

Sea level pressure:	1.013,2 hpa
Sea level temperature:	15° C
Sea level density:	1,225 kg/m ³
Vertical temperature gradient:	0,65° C/100 m

The maximum load depends on the planned flight altitude and the ambient temperature. It can be calculated (Appendix 4) or determined by the load charts.

4.3 Load Chart

The horizontal x-axis shows the ambient temperature in degree Celsius. The vertical y-axis shows the possible load A (gross lift) in kilogram at an envelope temperature of 120 °C. The thick horizontal line shows the maximum permitted take-off weight not to be exceeded. Use the following instructions to determine the possible lift.

1. Fix the ambient temperature on the horizontal axis.
2. Plot a line vertically upwards until the sea level graph is reached (1).
3. For altitude correction plot a line (2) following the ISA-curve until the graph of the relevant altitude is reached.
4. Read horizontally (3) across to the y-axis to find the available gross lift at the wanted altitude.

Example: The ambient temperature of 20 °C at sea level and a planned flight up to an altitude of 6.500 ft gives an available load of:

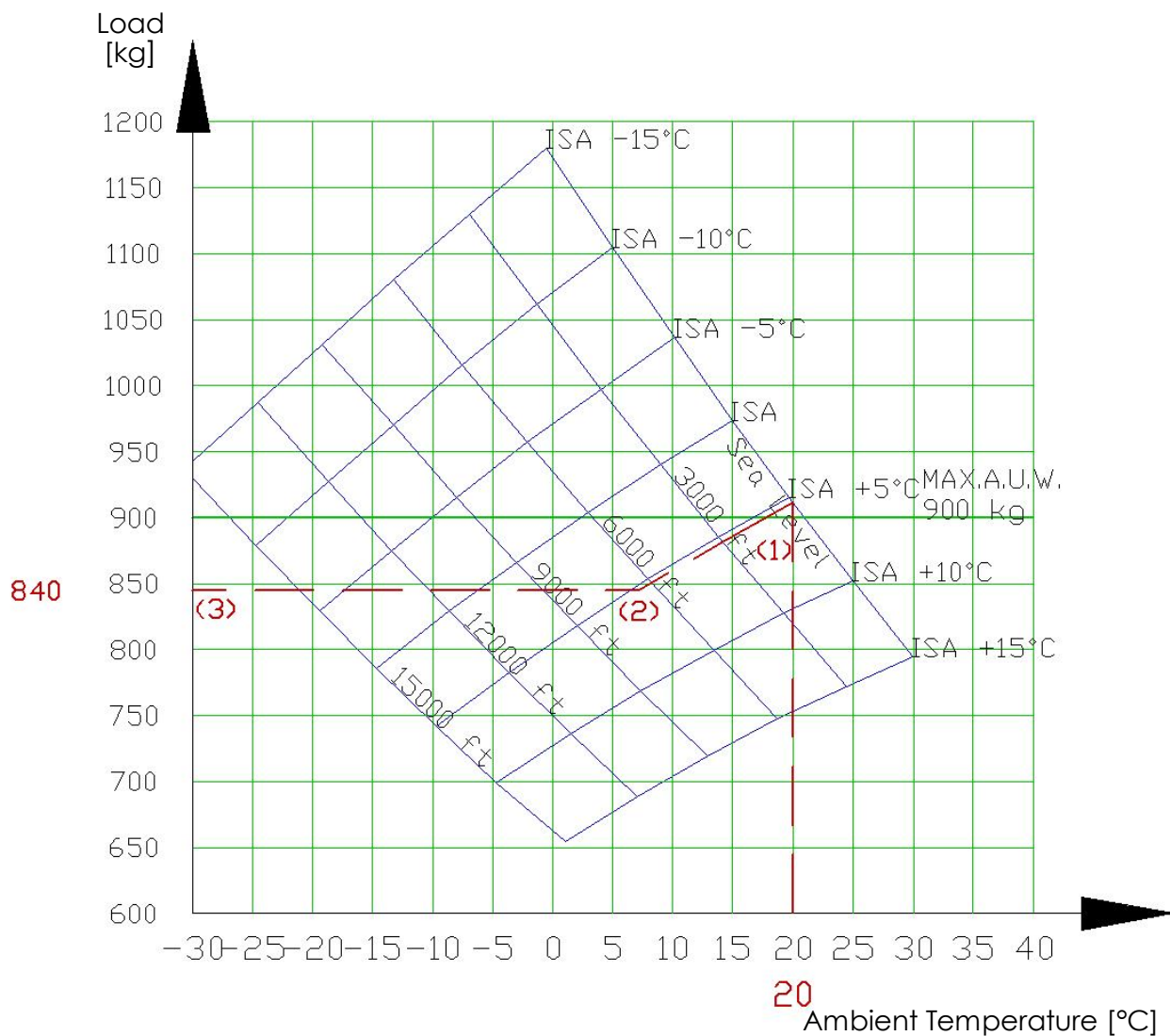
(Example GD/4) Gross lift of A = 840 kg

(Example GD/6) Gross lift of A = 1.420 kg

4.4 Load Chart AS 105 GD/4

Envelope volume $V = 3.000 \text{ m}^3$

Envelope temperature 120°C

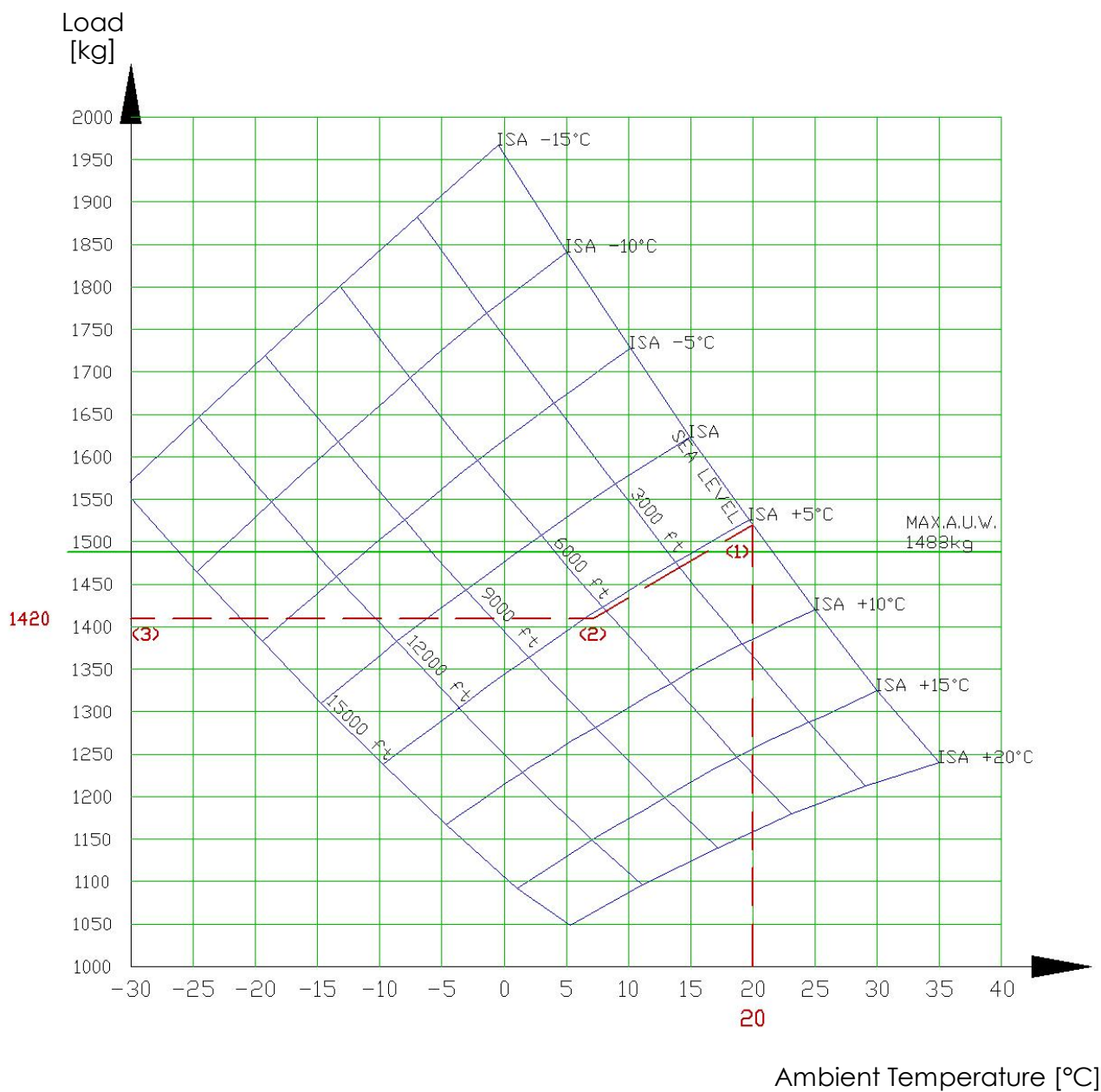


Calculation of the maximum permitted load

4.5 Load Chart AS 105 GD/6

Envelope volume $V = 5.000 \text{ m}^3$

Envelope temperature 120°C



Calculation of the maximum permitted load

4.6 Airworthiness Limitations (EASA Approved)

The airship should not be operated, if it is not airworthy. If one or more of the following circumstances occur the airship is declared as being **NOT AIRWORTHY**.

- Damage to the envelope fabric (holes, tears: above the equator larger than 5 mm diameter, below the equator larger than 10 mm diameter)
- Damage to the fins or rudder (holes, tears larger than 10 mm diameter)
- Damage to the catenary system (loadtapes, cords, etc.)
- Damage or malfunction of the burner system
- Leakage to the pressurised parts of the heating system including the propane cylinders
- Leakage of the fuel system
- Damage or malfunction of the propulsion engine
- Damage to the propeller
- Damage to the electric pressure fan system
- Damage or malfunction of the flight instruments (altimeter, variometer)
- Damage or malfunction of the engine monitoring instruments (RPM counter, radiator fluid temperature gauge, petrol tank contents gauge)
- Damage or malfunction of the envelope pressure gauge
- Damage to the landing gear or too low tyre pressure

WARNING: As a consequence the airship has to be landed as soon as possible and chapter 3 (Emergency Procedures) must be obeyed.

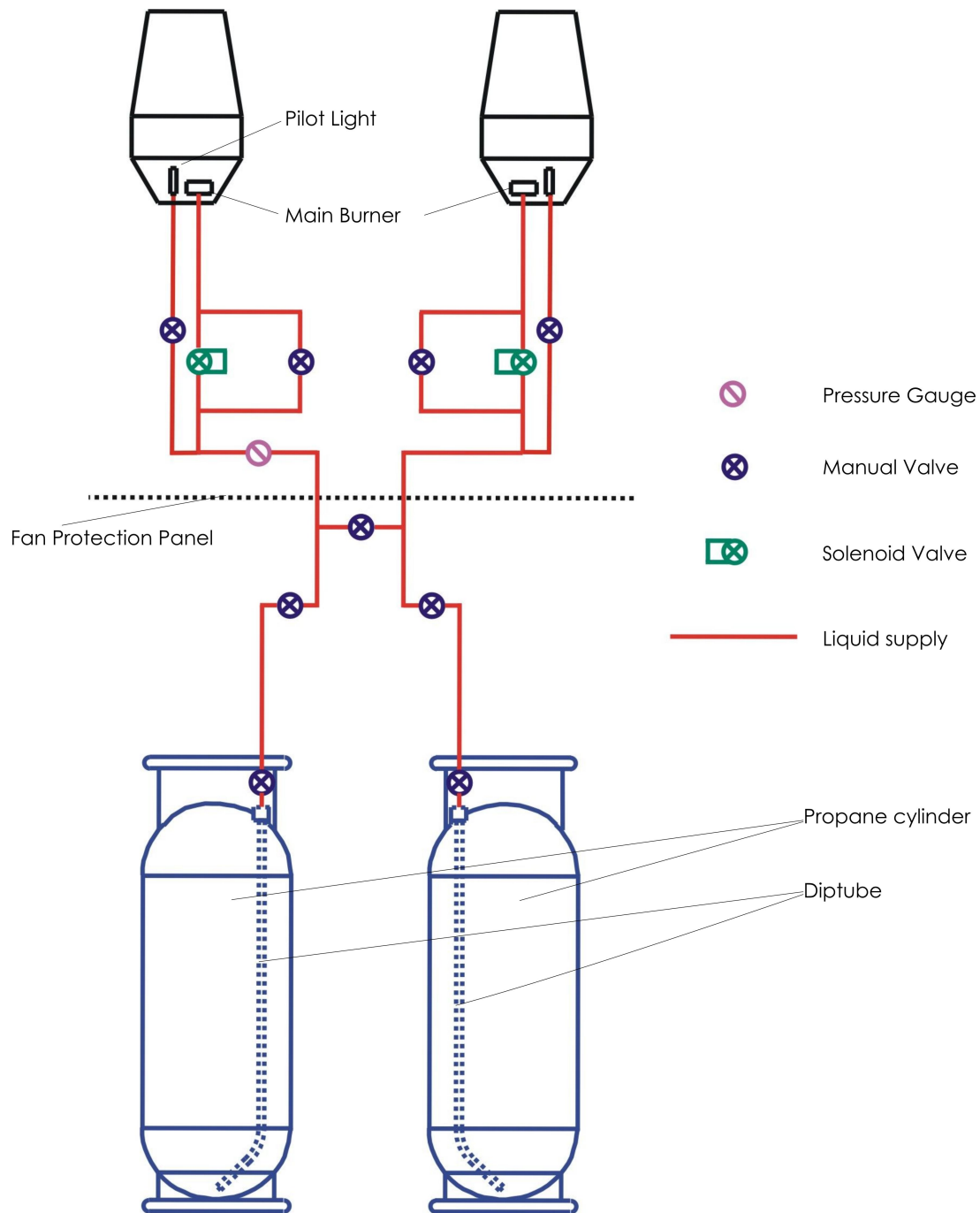
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Propane Cylinders (EASA Approved)

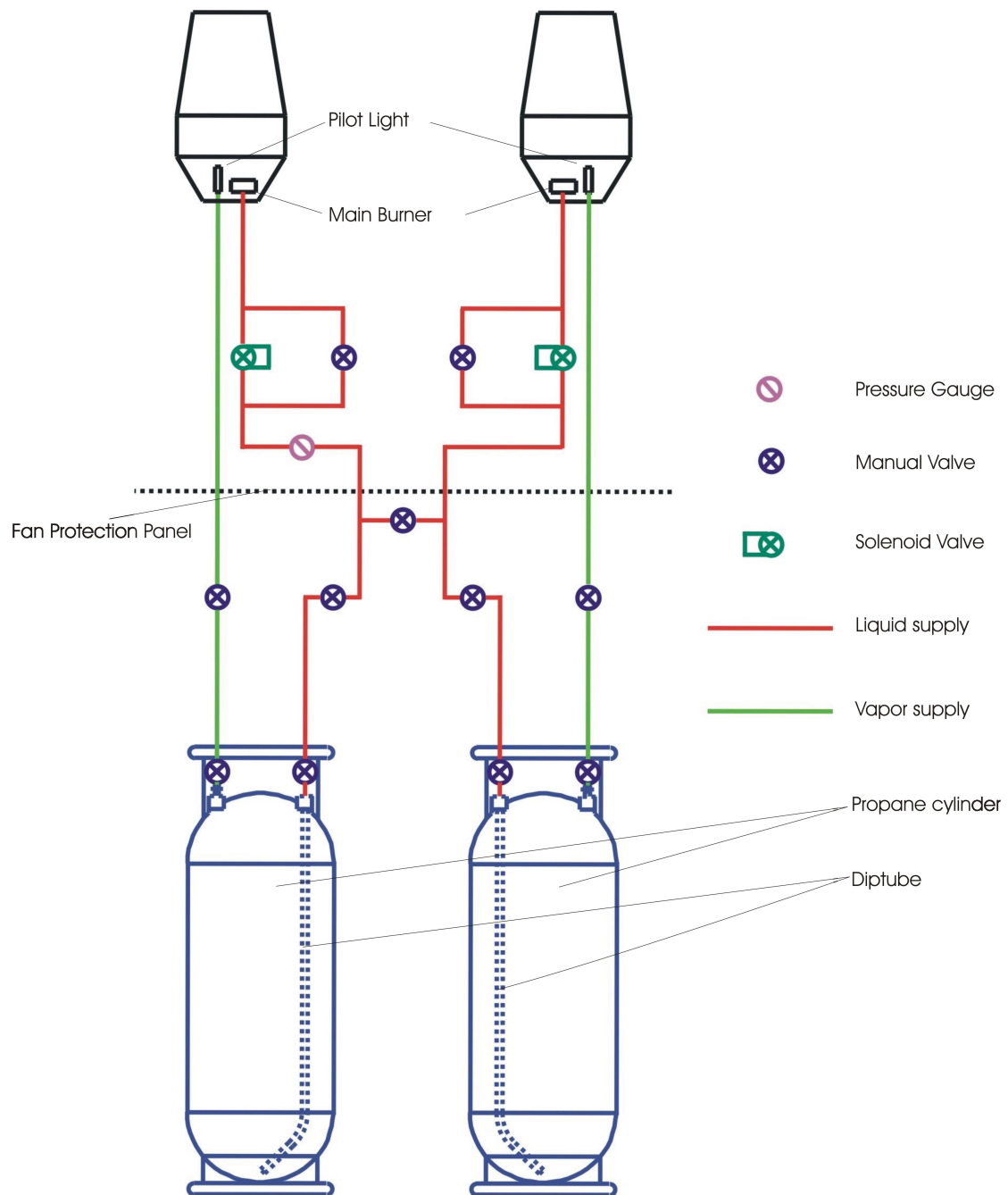
Available for	Manufacturer	Typ	Volume	Empty Weight	Capacity	max. Weight	Connecti on Ports
GD/4 and GD/6	Cameron	CB 426	69 l	21,7 kg	27,4 kg	49,1 kg	Rego or Tema
GD/6	Cameron	CB 2903	90,3 l	26,2kg	37,9kg	64,1 kg	
GD/4 and GD/6	T & C	V 30	69 l	21,7 kg	27,4 kg	49,1 kg	
GD/4 and GD/6	Schroeder	VA 50	50 l	15,5 kg	21,2 kg	36,1 kg	
GD/4 and GD/6	Schroeder	VA 70	70 l	18,8 kg	27,8 kg	46,6 kg	
GD/4 and GD/6	Worthington	CB 250-001	47 l	14 kg	19 kg	33 kg	
GD/4 and GD/6	Lindstrand	V 30 (X)	72 l	20 kg	30 kg	50 kg	
GD/6	Lindstrand	V 40 (X)	96 l	22 kg	40 kg	62 kg	

(X) Lindstrand propane cylinders are not available with vapor pilot light supply. Airships equipped with vapor pilot lights can therefore not be operated with Lindstrand propane cylinders.

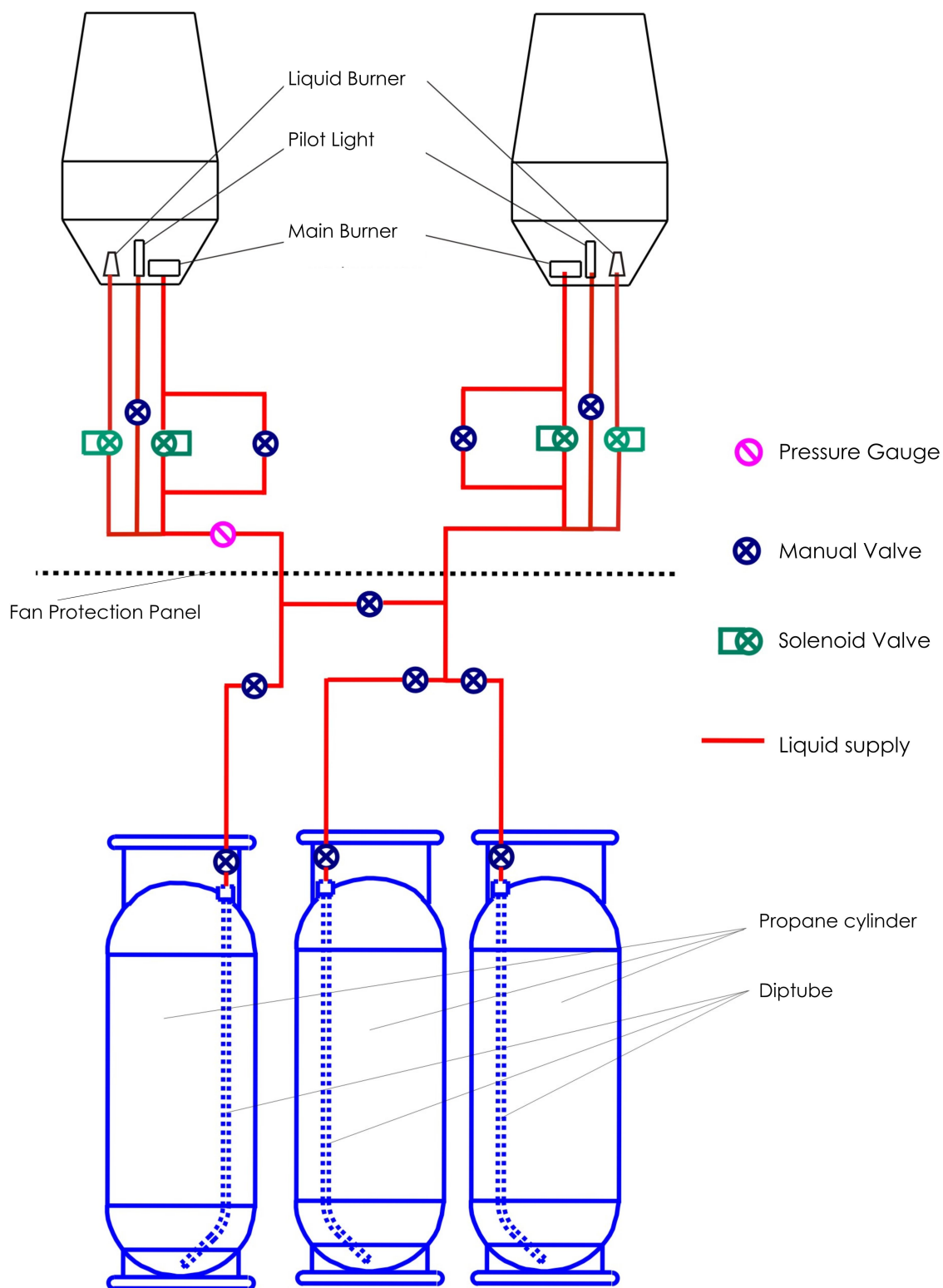
Propane System Liquid Pilot Lights GD/4



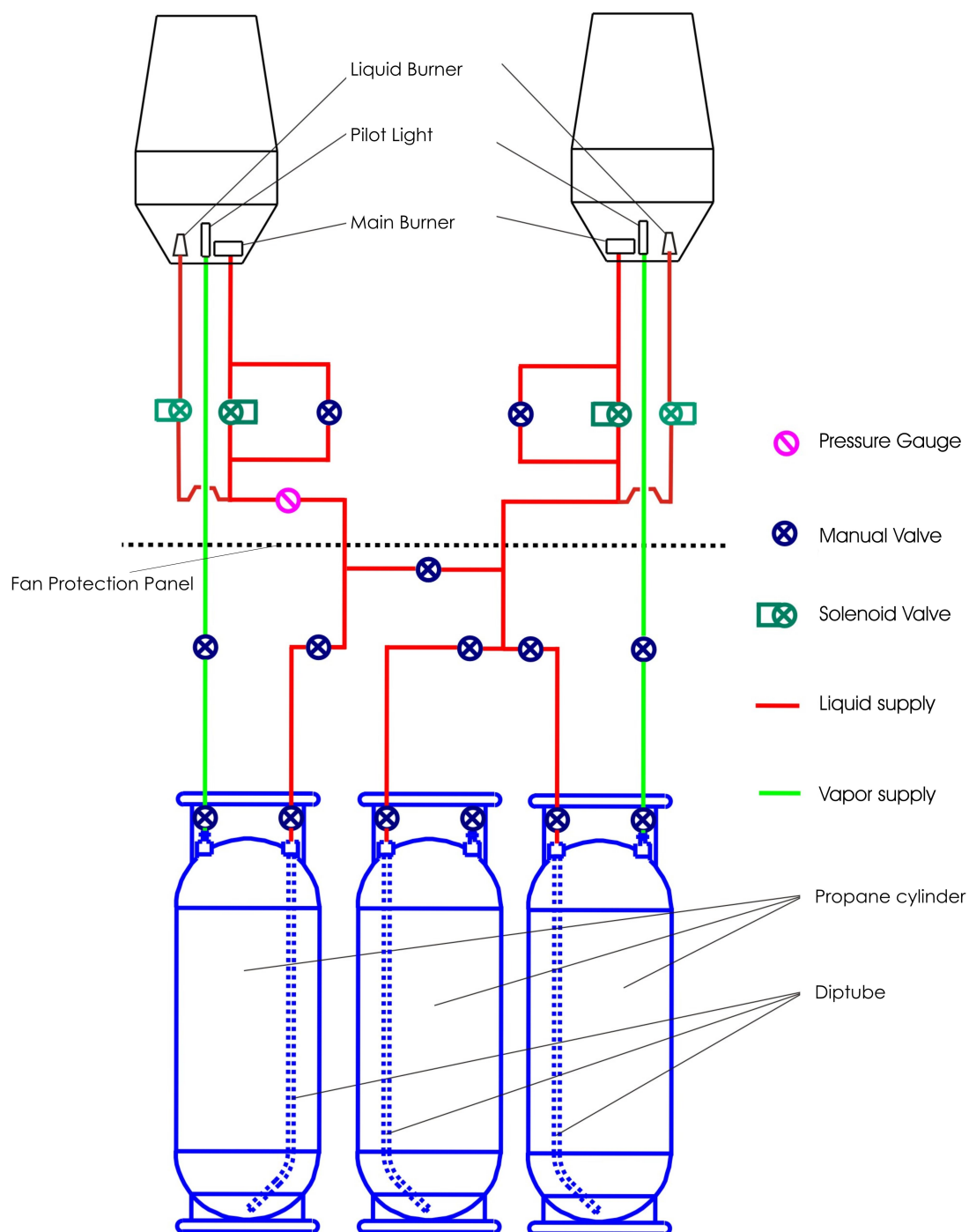
Propane System Vapor Pilot Lights GD/4



Propane System Liquid Pilot Lights GD/6



Propane System Vapor Pilot Lights GD/6



General Loading Formula

Calculation of Maximum Loading Weight

$$A = 0,3484 \cdot V \cdot p \left(\frac{1}{ta + 273} - \frac{1}{ti + 273} \right)$$

$$p = 1013,25 \cdot \left(1 - \frac{6,5 \cdot h}{288,15} \right)^{5,255} \text{ hPa}$$

A = total lift of the airship in kg

V = envelope volume in m³

p = air pressure in hPa

h = planned flight altitude in km

ti = average inner envelope temperature, given with 120°C

ta = ambient temperature at flight altitude in °C

ISA standard atmosphere is assumed. The temperature gradient is assumed to

$$\frac{\Delta T}{\Delta h} = \frac{6,5^\circ\text{C}}{1000\text{m}} \text{ for an altitude up to } h = 11\text{km}.$$

Example Calculation

Envelope GD/6

V = 5.000 m³

Planned flight altitude

h = 6.500 feet above sea level

Ambient air temperature

ta = +20°C above sea level

Total empty weight

m_{ges} = 710 kg

NOTE: This example is calculated with the GD/6 (envelope volume 5.000 m³). Operating a GD/4 (envelope volume of 3.000 m³) the load is lower.

$$p = 1013,25 \cdot \left(1 - \frac{6,5 \cdot h}{288,15} \right)^{5,255}$$

Auxiliary calculation: 1km = 3281ft → 1,981km = 6500ft

$$p = 1013,25 \cdot \left(1 - \frac{6,5 \cdot 1,981\text{km}}{288,15} \right)^{5,255} \quad p = 797\text{hPa}$$

$$A = 0,3484 \cdot V \cdot p \left(\frac{1}{ta + 273} - \frac{1}{ti + 273} \right)$$

with Ta = 7°C at planned flight altitude of h = 6500ft = 1,981km

$$A = 0,3484 \cdot 5000 \cdot 797 \left(\frac{1}{7 + 273} - \frac{1}{120 + 273} \right) \underline{\underline{A = 1423\text{kg}}}$$

The maximum available load is:

$$m_{P,\max} = A - m_{\text{gondula,empty}}$$

$$m_{P,\max} = 1423\text{kg} - 710\text{kg} = 713\text{kg}$$

mit $m_{P,\max}$ = maximum available payload

A = lift

$M_{\text{gondula,empty}}$ = empty weight

Calculation of the maximum permitted number of persons on board

Petrol fuel tank including maximum amount of fuel	M_{fuel}	40 kg
Total weight of all propane cylinders including propane	$M_{\text{propane,total}}$	150 kg
	sum:	190 kg

Hence, the free lift for persons on board is: $m_{\text{person,total}} = 523\text{kg}$

For the calculation the weight for persons is $m_{\text{person}} = 86\text{kg}$ is assumed. Thus 6 persons can be transported in this case.

$$x = \frac{523\text{kg}}{86\text{kg}} = 6,08$$

x = number of persons

NOTE: For the planned flight the maximum number of persons on board might be lower if the weight of individual persons is above 86 kg.